



Acoustics

Dr. Tamer Elnady – Dr. Adel Elsabbagh – Dr. Wael Akl
www.asugards.net

Standards and Regulations ***Chapter 18***

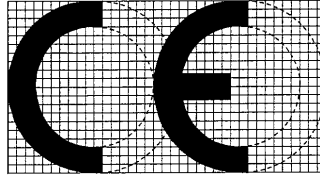
Why Standards and Regulations?

- 💡 Hearing Protection
- 💡 Sound Quality

What is regulated and Standardized?

- 💡 Regulations
 - Machines
 - Vehicles
 - Motor Vehicles
 - Airplanes
 - Workplace Environment
 - Dwellings
 - New Buildings
 - Existing Buildings
 - External Noise
- 💡 Standards
 - Measurement of Sound Power of any sound source

Regulations: Machines



EU Compliance

- ✦ EU Machinery Directive (89/392 EEC & 91/368 EEC)
- ✦ The technical documentation of the machine should contain information about the Noise and Vibration Levels.
- ✦ At the operator position.
- ✦ The running condition of the machine as well as the measurement methods should be given.

Regulations: Machines

Noise

- ✦ If the equivalent A-weighted sound level LA,eq is lower than 70 dB(A), that is to be indicated.
Example: $LA,eq < 70$ dB(A).
- ✦ If LA,eq is greater than 70 dB(A), the actual level is to be specified:
Example: $LA,eq = 80$ dB(A).
- ✦ If LA,eq is greater than 85 dB(A), then the A-weighted sound power level is to be given as well.
Example: $LA,eq = 96$ dB(A), $LW,A = 104$ dB(A).
- ✦ If the instantaneous C-weighted level, LC , exceeds 130 dB(C), that level is to be indicated.
Example: $LC = 135$ dB(C).

Regulations: Machines

Hand-arm vibrations

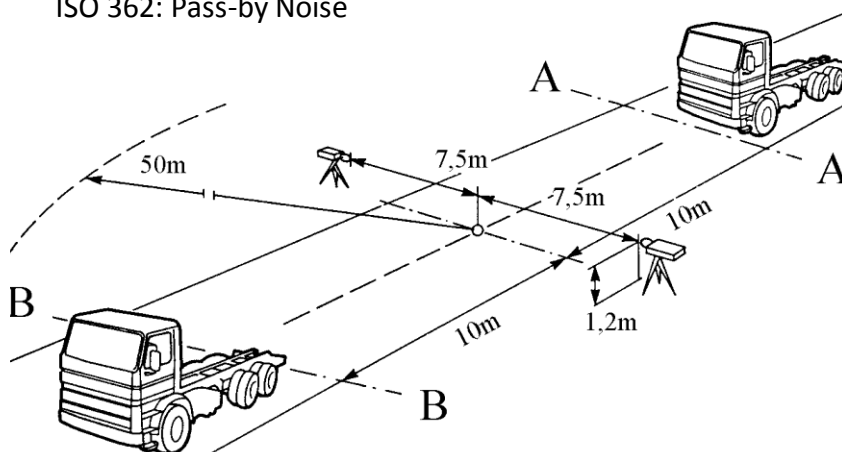
- ✦ If the frequency-weighted rms acceleration is less than 2.5 m/s^2 , that is to be indicated.
Example: $< 2.5 \text{ m/s}^2$.
- ✦ If is greater than 2.5 m/s^2 , the actual value is to be indicated.
Example: $= 2.8 \text{ m/s}^2$.

Whole body vibrations

- ✦ If the frequency-weighted rms acceleration, based on the relevant standard, is less than 0.5 m/s^2 , that is to be indicated.
Example: $< 0.5 \text{ m/s}^2$.
- ✦ If is greater than 0.5 m/s^2 , the actual value is to be indicated.
Example: $= 1.2 \text{ m/s}^2$.

Regulations: Motor Vehicles

ISO 362: Pass-by Noise



Regulations: Motor Vehicles

EU directives (70/157 EEC & 96/20 EC)

Vehicle category	Highest allowed sound level, dB(A)
Passenger car	74
Bus or truck with a total weight up to 3.5 tons	76
with a total weight up to 2 tons	
with a total weight over 2 tons, but < 3.5 tons	77
Bus with a total weight over 3.5 tons	78
with a motor power 150 kW	
with a motor power of 150 kW or higher	80
Truck with a total weight over 3.5 tons	77
with a motor power less than 75 kW	
with a motor power betw 75 kW and 150 kW	78
with a motor power over 150 kW	80
Motorcycle (depending on cylinder volume)	75-80
Moped	66-76

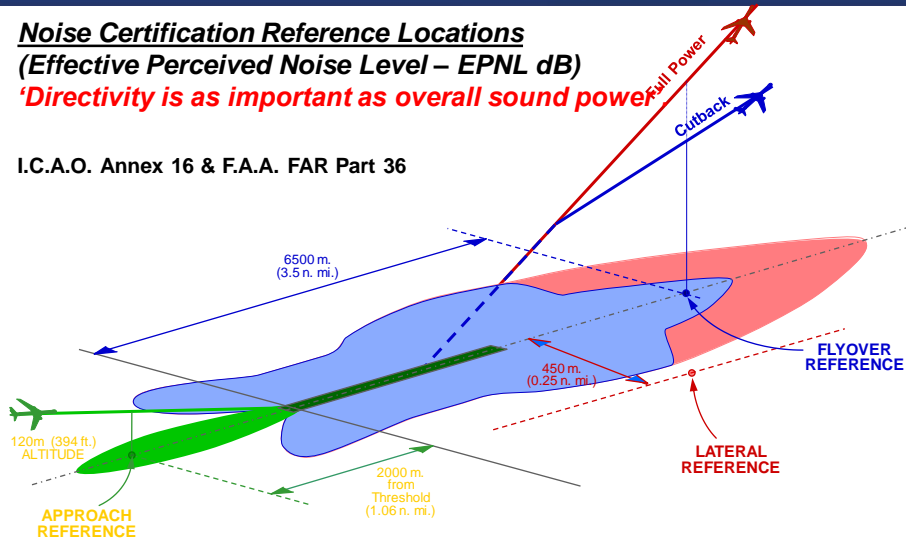
Regulations: Airplanes

- ✂ International Civil Aviation Organization (ICAO)
- ✂ Maximum limit for each aircraft based on maximum weight and number of engines

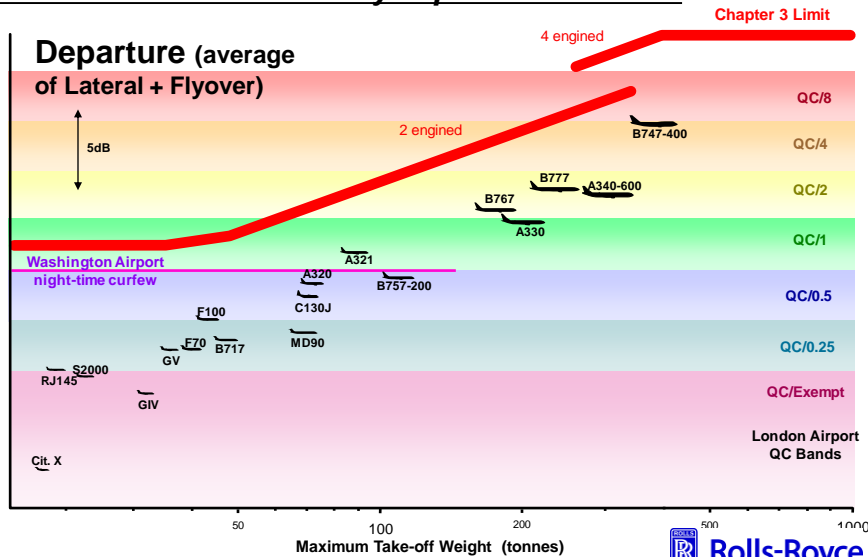
Noise Certification Reference Locations (Effective Perceived Noise Level – EPNL dB)

'Directivity is as important as overall sound power'

I.C.A.O. Annex 16 & F.A.A. FAR Part 36

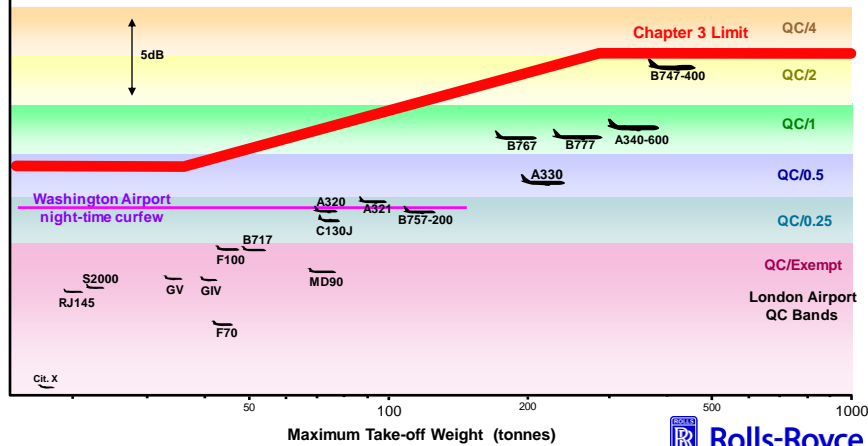


Noise levels for Rolls-Royce powered aircraft



Noise levels for Rolls-Royce powered aircraft

Arrivals



Regulations: Workplace Environment

- 🔊 Occupational Safety and Health Administration (OSHA)
- 🔊 OSHA noise exposure standards consist of a two-stage program:
 - Hearing conservation measures become mandatory at 85 dBA for an 8-hour day
 - Feasible engineering or administrative noise controls are required when exposures exceed 90 dBA.
- 🔊 Exposure to impulsive or impact noise should not exceed 140 dB peak sound pressure level

Regulations: Workplace Environment

- 💡 ***Hearing Conservation Programs*** - include annual audiometric testing and provision of hearing protectors.
- 💡 ***Engineering Controls*** - include reducing machinery noise through redesign, replacement with quieter equipment or by reducing the transmission of noise along the path from source to receiver.
- 💡 ***Administrative Controls*** - include reducing noise exposure by limiting the time an employee is exposed to given noise levels.

Regulations: Workplace Environment

$$\text{Noise Dose (D)} = C_1/T_1 + C_2/T_2 + C_N/T_N$$

D = Daily noise dose (must not exceed unity)

C = Actual exposure time at given noise level.

T = Permissible exposure time at that level.

Should be less than 1

Regulations: Workplace Environment

Duration Per Day, Hr	Permissible Exposure "Slow" Response, dBA
8	90
6	92
4	95
3	97
2	100
1.5	102
1	105
0.5	110
0.25 or less	115

Regulations in Egypt: Workplace Environment

No.	Type of place/activity	Maximum Allowable Equivalent Sound Level in dB(A)
1	Work premises with up to 8-hour shifts with the aim of limiting noise hazards on hearing.	90
2	Places of work that requires hearing signals and good audibility of speech.	80
3	Places of work with computers or typewriters or similar equipment.	70
4	Places of work for the follow up, measuring and adjustment of operations, with high performance.	65
5	Places of work for activities that require routine mental concentration.	60

Regulations in Sweden: External Noise

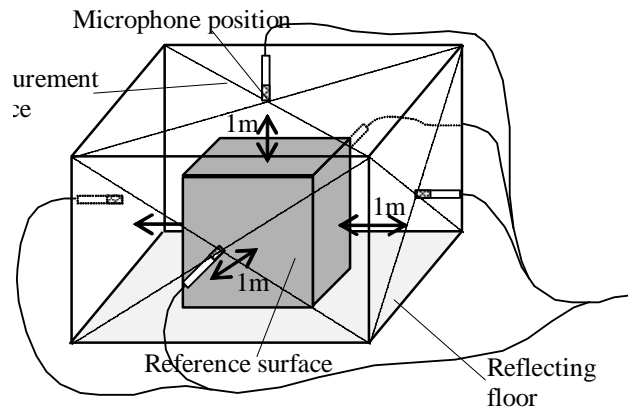
Equivalent sound level in dB(A) New site, (existing sites)				Highest sound level in dB(A)
Area	Daytime hours 07-18	Weekdays 18- 22, holidays 07-18	Nighttime hours 22-07	Instantaneous nighttime sound, 22-07
Workplaces without noisy activities	60, (65)	55, (60)	50, (55)	-
Dwellings and recreational areas adjacent to dwellings, and educational and health buildings	50, (55)	45, (50)	40, (45)	55, (55)
Recreational areas and mobile recreation where exposure to nature is important	40, (45)	35, (40)	35, (40)	50, (50)

Regulations in Egypt: External Noise

TYPE OF ZONE	Permissible limits for noise levels L_{eq} (dBA)		
	Day 7am-6pm	Evening 6pm-10pm	Night 10pm-7am
Industrial areas (Heavy Industries).	70	65	60
Commercial, administrative and downtown area.	65	60	55
Residential areas including some workshops or commercial businesses or on public roads.	60	55	50
Residential areas in the city.	55	50	45
Residential suburbs having low traffic flow.	50	45	40
Rural residential areas (Hospitals and gardens).	45	40	35

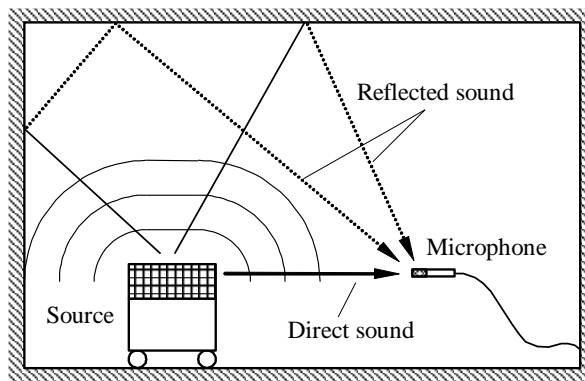
Measurement of Sound Power

💡 Direct Method



Measurement of Sound Power

💡 Comparison Method



Measurement of Sound Power

International standard	Classification of method	Test environment	Volume of source	Character of noise	SPLs obtainable	Optional information available
3741	Precision (grade 1)	Reverberation room meeting specified requirements	Preferable less than 1% of test room volume	Steady, broad-band	In one-third-octave or octave bands	A-weighted sound power level
3743-1	Engineering (grade 2)	Hard-walled test room		Steady, broad-band, narrow-band, or discrete frequency	A-weighted and in octave bands	Other weighted sound power levels
3743-2		Special reverberation test room				
3744	Engineering (grade 2)	Outdoors or in large room	Greatest dimension less than 15 m	Any	A-weighted and in one-third-octave or octave bands	Directivity information and sound pressure levels as a function of time; other weighted sound power levels
3745	Precision (grade 1)	Anechoic or semi-anechoic room	Preferable less than 0.5% of test room	Any		
3746	Survey (grade 3)	No special test environment	No restrictions: limited only by available test environment	Any	A-weighted	Sound pressure levels as a function of time; other weighted sound power levels
3747	Survey (grade 3)	No special test environment; source under test not movable	No restrictions	Steady, broad-band, Narrow-band, or discrete frequency	A-weighted	Sound power levels in octave band

